Executive Summary

The monitoring and reporting requirements for the City of San Diego (City) South Bay Water Reclamation Plant (SBWRP) and International Boundary and Water Commission (IBWC) International Wastewater Treatment Plant (IWTP) are outlined in NPDES Permit Nos. CA0109045 and CA0108928, respectively. Since effluent from the SBWRP and IWTP commingles as it is discharged through the South Bay Ocean Outfall (SBOO), the receiving water monitoring requirements are similar and a single ocean monitoring program is conducted to comply with both permits. The main objective of the South Bay ocean monitoring program is to assess the impact of wastewater discharged through the SBOO on the marine environment off southern San Diego, including effects on water quality, sediment conditions, and marine organisms. The study area centers around the SBOO discharge site, which is located approximately 5.6 km offshore at a depth of 27 m. Monitoring at sites along the shore extends from Coronado southward to Playa Blanca, northern Baja California, while offshore monitoring occurs in an adjacent area overlying the coastal continental shelf at sites ranging in depth from 9 to 55 m.

Prior to the initiation of wastewater discharge in 1999, the City of San Diego conducted a 3½ year baseline study designed to characterize background environmental conditions in the South Bay region in order to provide information against which post discharge data could be compared. Additionally, a region-wide survey of benthic conditions is typically conducted each year at randomly selected sites from Del Mar to the USA/Mexico border. Such studies are useful for evaluating patterns and trends over a broader geographic area, thus providing additional information to help distinguish reference areas from sites impacted by anthropogenic influences. The results of the 2007 annual survey of randomly selected stations are presented herein (see Chapters 8 and 9).

The receiving waters monitoring effort for the South Bay region may be divided into several major components, each comprising a separate chapter in this report: Oceanographic Conditions, Microbiology, Sediment Characteristics, Macrobenthic Communities, Demersal Fishes and Megabenthic Invertebrates, and Bioaccumulation of Contaminants in Fish Tissues. Chapter 1 presents a general introduction and overview of the ocean monitoring program for the South Bay Ocean Outfall region. In Chapter 2 monitoring data regarding various physical and chemical oceanographic parameters are evaluated to characterize water mass transport potential in the region. Chapter 3 presents the results of water quality monitoring conducted along the shore and in offshore waters, which includes the measurement of bacteriological indicators to assess potential effects of both natural and anthropogenic inputs, and to determine compliance with 2001 California Ocean Plan (COP) water contact standards. The results of benthic sampling and analyses of soft-bottom sediments and their associated macrofaunal communities are presented in Chapters 4 and 5, respectively. Chapter 6 presents the results of trawling activities to assess the status of bottom dwelling (demersal) fish and megabenthic invertebrate communities. Bioaccumulation studies to determine whether contaminants are present in the tissues of local species supplement the monitoring of fish populations and are presented in Chapter 7. In addition to the above activities, the City and IBWC support other projects relevant to assessing ocean quality in the region. One such project is a remote sensing study of the San Diego/Tijuana coastal region. These results are incorporated herein into the interpretations of oceanographic and microbiological data (see Chapters 2 and 3).

The present report focuses on the results of all ocean monitoring activities conducted in the South Bay region during 2007. An overview and summary of the main findings for each of the major components of the monitoring program are included below.

OCEANOGRAPHIC CONDITIONS

Water temperatures, especially at bottom depths, were generally cooler during the spring and fall months of 2007 when compared to previous years.

This was likely due to strong upwelling events that occurred during these times. In contrast, surface temperatures were extremely high in August, coincident with near record air temperatures. Thermal stratification of the water column followed typical patterns with maximum stratification in mid-summer and reduced stratification during the winter. Relatively low annual rainfall generated less stormwater runoff in 2007 than in previous years. DMSC aerial imagery detected the wastewater plume in sub-surface waters above the southern diffuser leg of the SBOO on several occasions between January–March and November–December when the water column was well mixed. In contrast, the plume was deeply submerged between June and October when the water column was stratified. A review of historical data did not reveal any major changes in water quality parameters that could be attributed to the beginning of outfall operations in January 1999. Instead, these data indicate that other factors such as stormwater runoff and large-scale oceanographic events (e.g., El Niño) explain most of the observed temporal and spatial variability in water quality parameters in the South Bay region.

MICROBIOLOGY

Densities of indicator bacteria (total and fecal coliforms, enterococcus) at shore and kelp stations sampled in the South Bay region were lower overall in 2007 than in previous years, which resulted in higher compliance with the various 2001 COP standards. Although elevated bacterial densities occurred occasionally along the shore and at some nearshore stations, these data did not indicate shoreward transport of the SBOO wastewater plume during the past year. Instead, bacteria data and satellite imagery indicate that turbidity flows originating from the Tijuana River and Los Buenos Creek, or associated with stormwater and surface runoff following storm events are more likely to impact water quality along and near the shore. For example, shore stations located near the Tijuana River and Los Buenos Creek have historically had higher fecal coliform concentrations than stations located further north. Historical analyses of various water quality parameters have also demonstrated that the general relationship between rainfall and elevated bacteria levels has remained consistent since sampling began in 1995.

Data from offshore monitoring sites in 2007 suggest that the wastewater plume from the SBOO was confined to sub-surface waters from April through October when the water column was stratified. In contrast, bacterial counts indicative of wastewater were evident in surface waters near the SBOO during January–March, November and December when the water column was well-mixed. There was no evidence that the wastewater plume impacted any of the kelp or shore stations.

SEDIMENT CHARACTERISTICS

The composition of sediments at the various benthic sites sampled in the South Bay region during 2007 varied from fine silts to very coarse sands (or other materials), which is similar to patterns seen in previous years. The large variation in sediment composition may be partially attributed to the multiple geological origins of red relict sands, shell hash, coarse sands, and other detrital sediments. In addition, deposition of sediments originating from the Tijuana River and to a lesser extent from San Diego Bay may contribute to higher silt content at some of the stations located near the outfall and to the north. There was no evident relationship between sediment composition and proximity to the outfall discharge site.

Contaminant concentrations in South Bay sediments, including organic loading indicators such as sulfides, total nitrogen (TN) and total organic carbon (TOC), trace metals, pesticides, PCBs and PAHs, were generally low compared to other areas of the southern California continental shelf. Concentrations of sulfides, TN and TOC, as well as several metals, tended to increase as sediments became finer. Further, levels of the organic loading indicators have not shown changes around the outfall or elsewhere coincident with the start of wastewater discharge in early 1999. Only two metals exceeded Effects Range Low (ERL) environmental threshold values during the year:

(1) the ERL for arsenic was exceeded in sediments from a single site located offshore of the SBOO; (2) the ERL for silver was exceeded in sediments from stations located throughout the monitoring area. Other contaminants were detected rarely (i.e., PCBs and pesticides) or in only low concentrations (i.e., PAHs) in SBOO sediments during 2007. Overall, there was no pattern in sediment contaminant concentrations relative to the SBOO discharge site.

MACROBENTHIC INVERTEBRATE COMMUNITIES

Benthic communities in the SBOO region included macrofaunal assemblages that varied along gradients of sediment structure and depth. Assemblages surrounding the SBOO in 2007 were similar to those that occurred during previous years. Most sites contained high abundances of the spionid polychaete *Spiophanes bombyx*, a species characteristic of other shallow-water assemblages in the Southern California Bight (SCB). Numbers of *S. bombyx* collected during 2007 were the highest recorded since monitoring began in 1995.

The South Bay shallow water benthos was represented by several distinct sub-assemblages that occurred at sites differing in sediment structure (i.e., either more fines or more coarse materials), and to a lesser degree, TOC content. A different type of assemblage occurred at sites located in slightly deeper water where sediments contain finer particles, and which probably represents a transition between assemblages occurring in shallow sandy habitats and those occurring in finer mid-depth sediments off southern California. This assemblage also contained relatively high numbers of *S. bombyx*, but was distinguished from the shallow-water assemblages by denser populations of the polychaetes *Spio maculata* and *Mooreonuphis* sp SD1, and the amphipod *Ampelisca cristata cristata*. Finally, sites with sediments composed of relict red sands or varied amounts of other coarse sands or shell hash were characterized by unique assemblages.

Species richness and total infaunal abundance values also varied with depth and sediment type, although there were no clear patterns relative to the outfall. Overall abundance and species richness were at their highest levels since monitoring began in the region. Patterns of region-wide abundance fluctuations over time appear to mirror historical patterns for *S. bombyx*. The range of values for most community parameters was similar in 2007 to that seen in previous years, and most environmental disturbance indices such as the BRI and ITI were characteristic of undisturbed sediments. In addition, changes in benthic community structure in the South Bay region that occurred during the year were similar in magnitude to those that have occurred previously and elsewhere off southern California. Such changes often correspond to large-scale oceanographic processes or other natural events. Overall, benthic assemblages in the region remain similar to those observed prior to wastewater discharge and to natural indigenous communities characteristic of similar habitats on the southern California continental shelf. There was no evidence that wastewater discharge has caused degradation of the marine benthos in the SBOO monitoring region.

DEMERSAL FISH AND MEGABENTHIC INVERTEBRATE COMMUNITIES

As in previous years, speckled sanddabs continued to dominate fish assemblages surrounding the SBOO during 2007. This species occurred at all stations and accounted for 68% of the total catch. Other characteristic, but less abundant species included the hornyhead turbot, roughback sculpin, California lizardfish, longfin sanddab, English sole, yellowchin sculpin, California tonguefish and California scorpionfish. Most of these common fishes were relatively small, averaging less than 20 cm in length. Although the composition and structure of fish assemblages varied among stations, these differences were mostly due to variations in speckled sanddab populations.

Assemblages of relatively large (megabenthic) trawl-caught invertebrates in the region were

similarly dominated by one prominent species, the sea star *Astropectin verrilli*. Variations in megabenthic invertebrate community structure generally reflected changes in the abundance of this species, as well as other characteristic species such as the sea urchin *Lytechinus pictus*, the sand dollar *Dendraster terminalis*, and the shrimp *Crangon nigromaculata*. Two species which usually do not occur in South Bay trawls, the nereid polychaete *Platynereis bicanaliculata*, and the pea crab *Pinnixa franciscana* were captured during the year. These two species were apparently feeding on squid eggs that were also collected in one particular trawl.

Overall, results of the 2007 trawl surveys provide no evidence that the discharge of wastewater has affected either demersal fish or megabenthic invertebrate communities in the region. The relatively low numbers and low species richness of organisms found in the SBOO surveys are consistent with the depth and sandy habitat in which the trawl stations are located. Further, patterns in the abundance and distribution of species were similar at stations located near the outfall and farther away, indicating a lack of anthropogenic influence. Changes in these communities instead appear to be more likely due to natural factors such as changes in water temperatures associated with large-scale oceanographic events (e.g., El Niño) and the mobile nature of many species. Finally, the absence of any indicators of disease or other physical abnormalities in local fishes suggests that populations in the area remain healthy.

CONTAMINANTS IN FISH TISSUES

There was no clear evidence to suggest that tissue contaminant loads in fish captured at the SBOO monitoring sites were affected by the discharge of wastewater in 2007. Although several samples contained metal concentrations that exceeded pre-discharge maximum values, concentrations of most contaminants were not substantially different from pre-discharge data. In addition, the few samples that did exceed pre-discharge values were distributed widely among the stations and showed no pattern relative to wastewater discharge. Further, all contaminant values were within the range of those reported previously for SCB fishes

The occurrence of both metals and chlorinated hydrocarbons in the tissues of South Bay fishes may be due to many factors, including the ubiquitous distribution of many contaminants in coastal sediments off southern California. Other factors that affect the bioaccumulation and distribution of contaminants in local fishes include the different physiologies and life history traits of various species. Exposure to contaminants can vary greatly between species and even among individuals of the same species depending on migration habits. For example, fish may be exposed to pollutants in a highly contaminated area and then move into a region that is less contaminated. This is of particular concern for fishes collected in the vicinity of the SBOO, as there are many other point and non-point sources in the region that may contribute to contamination.

SAN DIEGO REGIONAL SURVEY

For the summer 2007 regional survey the City of San Diego revisited the same 40 randomly chosen sites that were initially selected for sampling in 1997 in order to compare benthic conditions 10 years later. Of these, a total of 39 sites ranging in depth from 13–216 m were successfully sampled during 2007.

The distribution of sediment particles at these regional stations was similar to that seen in previous years. Only seven of the sites showed any substantial change in mean particle size between 1997 and 2007. As in the past, there was a trend towards higher sand content in shallow nearshore areas compared to finer sands and silt at deeper offshore sites. For example, sediments from depths ≤30 m were composed of about 90% sands and 9% fines, whereas sediments at depths of 30–120 m were about 60% sands and 37% fines. Deeper sites occuring at depths of 120–200 m contained sediments that were about 52% sand and 47% fines. Exceptions to the general pattern occurred in mid-shelf sediments offshore of the SBOO, as well as along the Coronado Bank, a southern rocky ridge located soutwest of Point Loma at a depth of 150–170 m. Sediment composition at

the stations from these areas tended to be coarser and have less fine materials than regional mid-shelf stations located off of Point Loma and further to the north. Overall, the sediments throughout the San Diego region reflect the diverse and patchy types of habitats that are common to the SCB.

Patterns in sediment chemistries at the regional sites generally followed the expected relationship of increasing concentrations with decreasing particle size. Concentrations of organic indicators, metals, and other contaminants were higher along the mid-shelf and deep water strata where the percentage of fines was typically greatest. The regional sediment survey data did not show any pattern of contamination relative to wastewater discharges.

The SCB benthos has long been considered a heterogeneous habitat, with the distribution of species and communities varying in space and time. The mainland shelf of this region consists largely of an *Amphiodia* (brittle star) mega-community with other sub-communities representing simple variations determined by differences in substrate type and microhabitat. Results of the 2007 and previous regional surveys off San Diego generally support this characterization. In addition, there were no substantial changes in community parameters between the 1997 and 2007 surveys. Therefore, results from 2007 support the conclusion that benthic assemblages in the vicinity of the South Bay and Point Loma outfalls, as well as dredge material disposal sites in the region have maintained a benthic community structure consistent with regional assemblages sampled in the past and throughout the entire SCB.

One third of the regional benthic sites sampled off San Diego in 2007 were characterized by an assemblage dominated by the ophiuroid *Amphiodia urtica*, a dominant species along the mainland shelf of southern California. Co-dominant species within this assemblage included other taxa common to the region such as the bivalve *Axinopsida serricata*. In contrast, the dominant species of other assemblages (or sub-assemblages) varied according to the sediment type or depth. For example, polychaete worms such as *Mediomastus* sp and *Monticellina siblina* were numerically dominant in mixed, sandy sediments. Another shallow shelf assemblage was characterized by coarser sediments, which were dominated by the spionid polychaete *Spiophanes bombyx*. The deepest stations (>130 m) had relatively high percentages of fine particles and organic carbon concentrations. These sites were characterized by relatively low species richness and abundance values, and were dominated by several different species of polychaetes (e.g., *Mediomastus* sp, *Paraprionospio pinnata*). Another deepwater assemblage with a lower percentage of fines and much higher TOC levels was characterized by high abundances of species found infrequently in other assemblages (e.g., *Aphelochaeta glandaria*, *Ceacum crebricinctum*).

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